



Toward Establishing a NOAA Ecological Forecasting System

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and the EFS Working Group**
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Outline



- Purpose
- Issue
- Background
- Discussion

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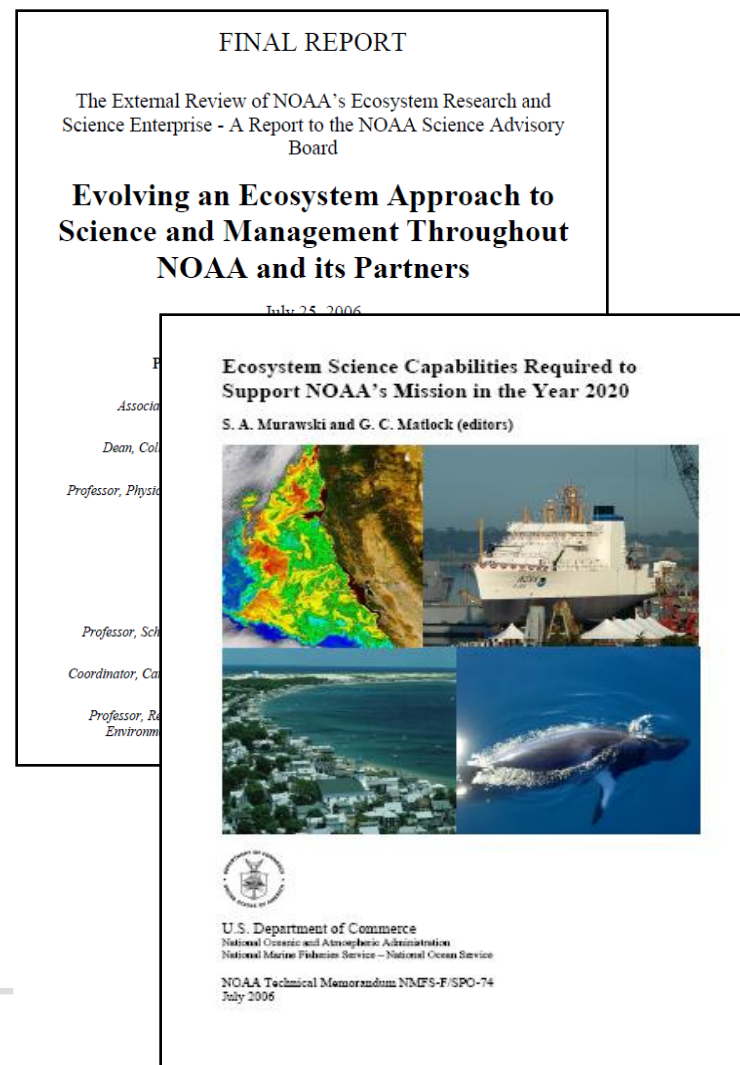


Purpose



- Two recent policy documents charged NOAA with developing more robust ecological forecasting capabilities
 - **Tactical:** External Ecosystem Task Team Report initiated by the SAB
 - **Strategic:** Ecosystem Science Capabilities Required to Support NOAA's Mission in the Year 2020

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Purpose

- Cross NOAA team has since worked to develop approaches and solutions to recommendations
- Presentations to the NOC, RC, SAB ESMWG, AA's and key supporters
- Formalized approach is necessary for progress
- Path forward is proposed in the NOAA Ecological Forecasting System Resolution

Key Supporters

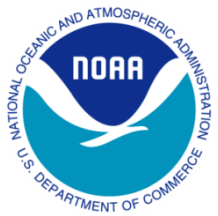
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Purpose

- Informational and Coordination Briefing in preparation for presentation to the NEP/NEC
- Desired Outcomes from Transition Managers
 1. Reaction to concept of a NOAA Ecological Forecasting System as an important strategic opportunity for NOAA
 2. Solicitation of recommendations for moving forward on establishing a NOAA Ecological Forecasting System as stipulated in the presentation, resolution and 4-pager

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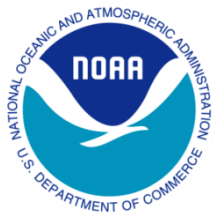


Issue



- NOAA research efforts produce a number of important forecast products
- Transition to operations occurs internally and externally via formal and informal pathways
- National Weather Service products and single sector forecasts are the most mature
- Ecological forecasts are the least mature due to their inherent complexity and dependencies

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Issue

- Lack of a framework for the long-term application/operation of ecological forecasts has become a major issue leading to:
 - **“Orphaned” forecast products – wasted development**
 - **“Blocked pipeline” for new products – backlog**
 - **“Backbone” capabilities not utilized – lost leveraging**
 - **“Ad hoc” development – inefficiency**
 - **“Holistic” management not achieved – lack of integration**

Problems will only accelerate as field matures and management demand increases

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Issue



- An Ecological Forecasting System is proposed as one possible solution allowing:

Capabilities

- Efficient and coordinated development and maintenance of ecological forecast products
- Extensive agility to mobilize capacities, and gained opportunities for leveraging and collaborating
- Full utilization of NOAA's existing environmental prediction infrastructure, observations, data, and product delivery
- Ability to affect ecosystem management decisions where the need is greatest

Outcomes

- Protected, preserved and restored biodiversity and ecosystem services, including water quality
- Increased human, ocean and ecosystem health
- Weather and water hazard mitigation
- Climate adaptation and stabilization

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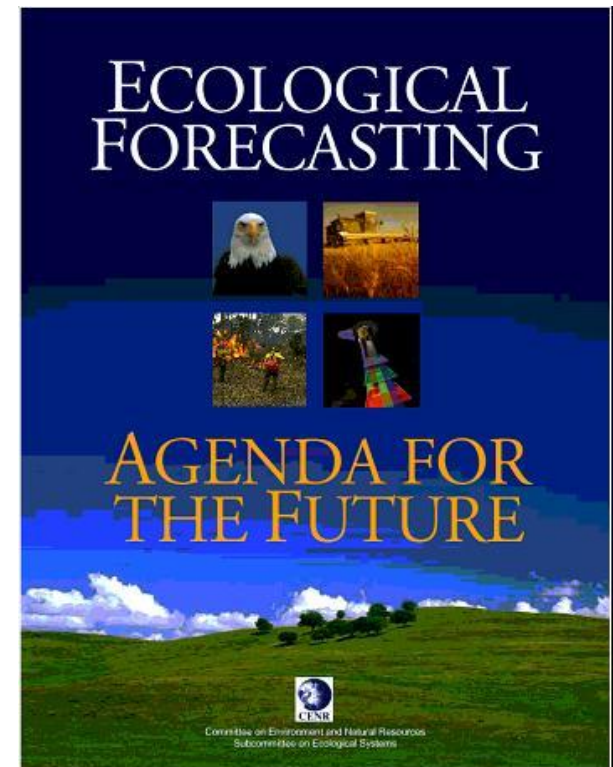


Background



What is an Ecological Forecast?

- “Ecological forecasts predict the effects of biological, chemical, physical, and human-induced changes on ecosystems and their components.” (CENR, 2001)
- Ecological forecasts cover a wide range of space and time scales
- Ecological forecasts serve as an integration mechanism across multiple disciplines





Background



Why are Ecological Forecasts Needed?

- Policy and scientific literature point to ecological forecasting as a priority need
- Ecosystem-based management requires ecological forecasts
- Ability to address our Nation's most pressing issues proactively rather than reactively

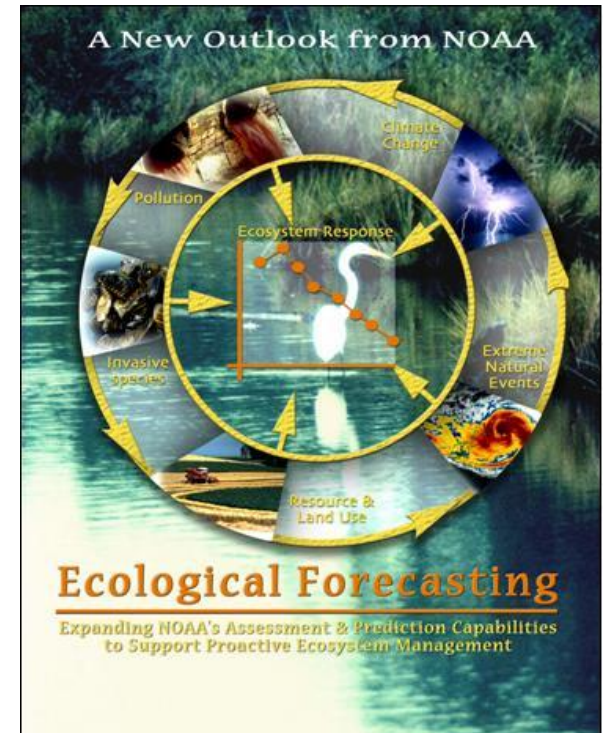




Background

Why NOAA?

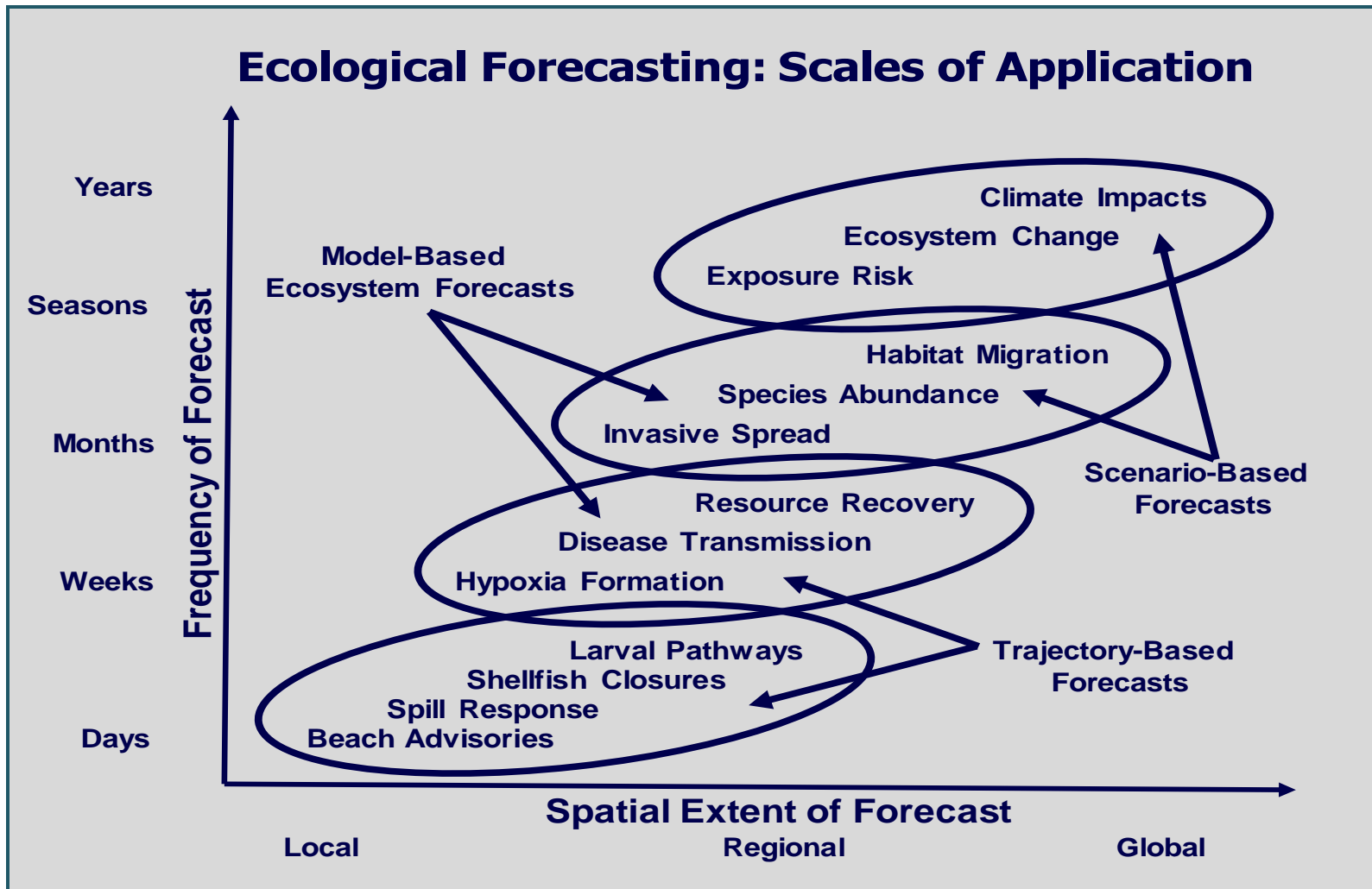
- NOAA has a long history of forecasting dating back to the beginning of the national ocean and weather services
- Achievement of NOAA's many mandates need ecological forecasts to be fully realized
- NOAA is best suited with legislation, mandates, expertise and infrastructure to create an ecological forecasting system





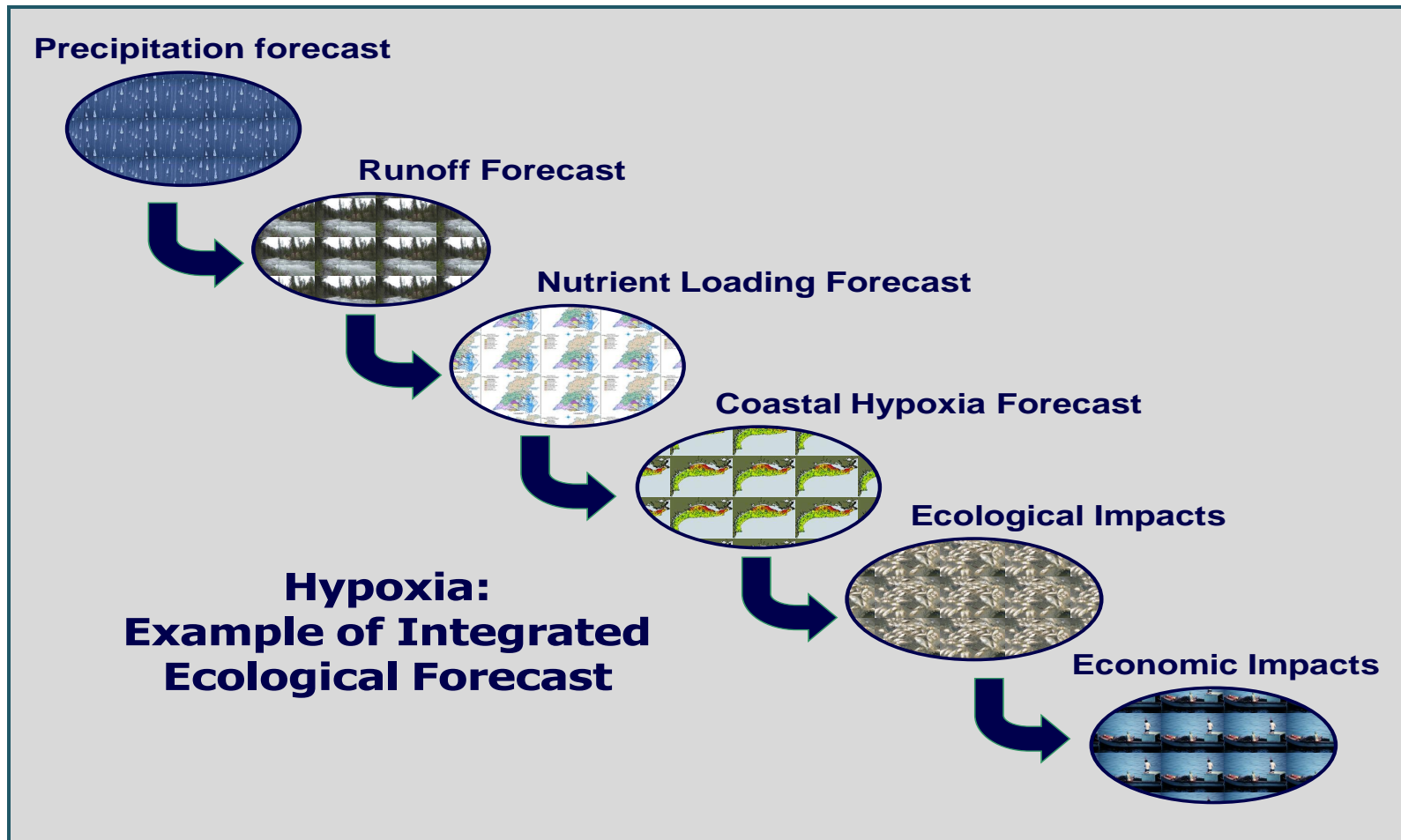
Background

Building on Existing Infrastructure





Background





Background



Why Now?

- Understanding and technology have matured to a level allowing some application to ecological issues
- There is increasing demand from regions and stakeholders
- Planning and policy documents highlight the need for NOAA to play a leading role in the production of ecological forecasts

ETT
Report

SAB
Report

20 yr
Vision

5 yr
Plan

AGM

OPTF listening
session

Ocean Policy
Taskforce



**Great Lakes
Restoration
Initiative**



**Chesapeake
Executive
Order**



Discussion



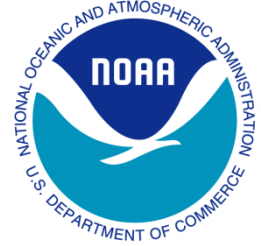
Present Status of NOAA ecological forecasts

- Broad NOAA corporate support not yet translated into coordinated actions
- Isolated activities within one LO or one discipline with minimal leverage of capabilities across NOAA and its partners
- Difficult transition from research to stable long-term distribution and operations
- > 40 ecological research and quasi-operational models



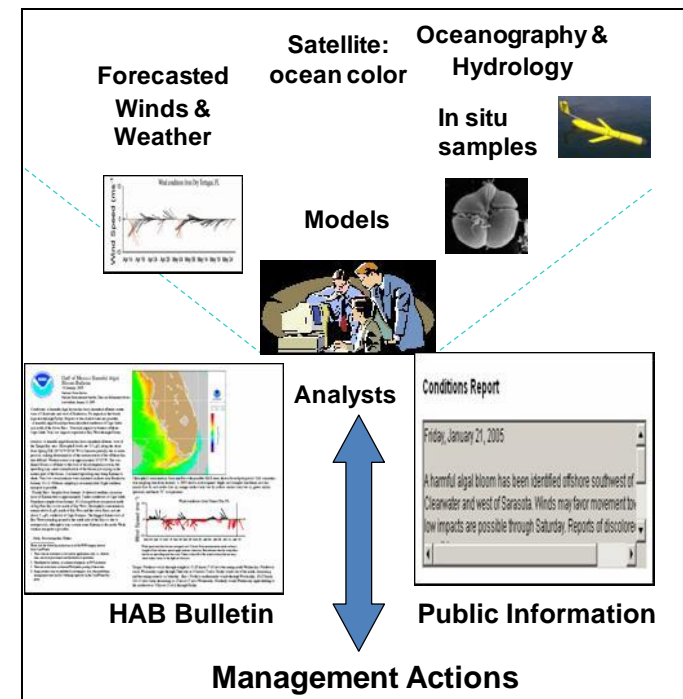


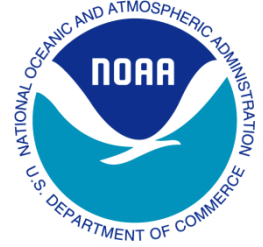
Discussion



Example: HABs in the Gulf of Mexico

- Supported by legislation (HABHRCA)
- Demanded by state coastal, resources, and health managers and the public
- Operational off Florida coast since 2004
 - Makes use of oceanography, hydrology, and remote sensing information
 - Predicts initiation, movement and landfall of harmful algal blooms on coastal areas
 - Rapid dissemination to managers and the public
- Expansion of the system nationally has been problematic and highlights the difficulties faced by ecological forecasts





Discussion

EFS Vision

- NOAA's Ecological Forecasting System provides the Nation with accurate, reliable, and understandable ecological forecasts for decision making and stewardship of the oceans, coastal zones, and the Great Lakes

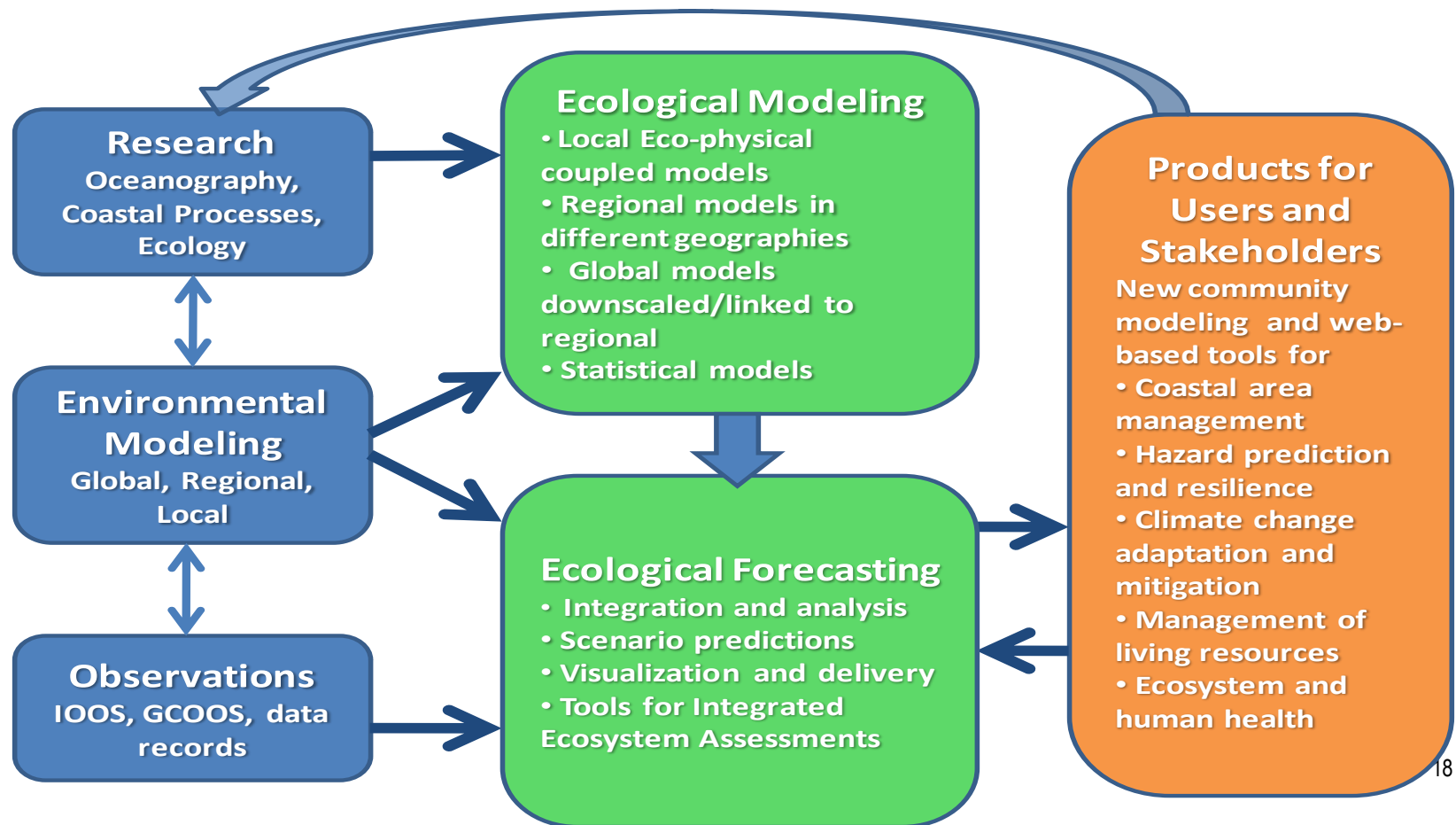
Characteristics of the EFS

- Designed to address priority requirements and to achieve a full research to applications capability
- Leverages resources, knowledge, infrastructure, and partners both within and outside of NOAA
- Corporate approach for sustained development, application and maintenance of ecological forecasts
- Supports the full continuum of NOAA ecological forecasts from short-term to scenario based forecasts



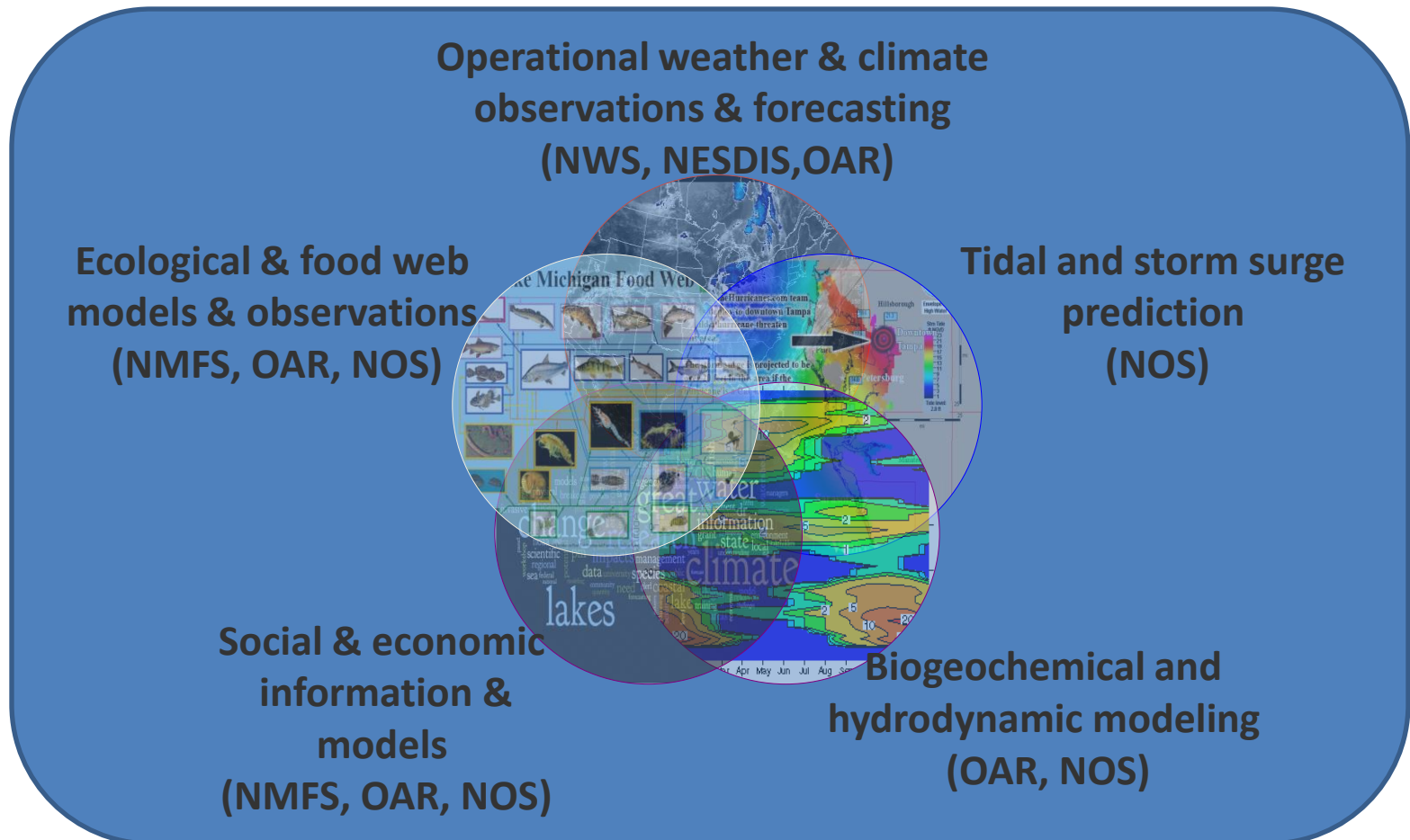
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EFS Will Integrate Disciplines and Sectors





EFS Will Also Integrate LO capabilities





Discussion



Resolution: NOAA Executive Decides to:

- Endorse the creation of a NOAA Ecological Forecasting System
- Take necessary actions to develop and operate a broad suite of integrated forecasts
- Formalize the establishment of an Ecological Forecasting System Working Group (EFSWG) initially within the Coastal Integration Enterprise to support NOAA's Coastal Strategy
- Nominate LO representatives to the EFSWG
- Support the establishment of a pilot EFS prototype in the Chesapeake Bay area.



Discussion



Why is this an issue for the Transition Managers?

- An EFS is a strategic investment, with NOAA Program and system level requirements and priorities
- The EFS would improve transition of research into applications
- Trans-disciplinary collaboration is indispensable: physical, chemical, biological and societal observations, data and information
- Cross-LO leveraged resources, knowledge, infrastructure

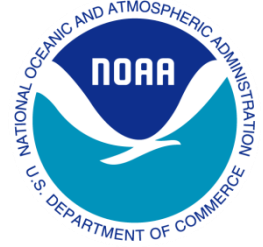


Discussion

- Partnerships both within and outside of NOAA
- Support needed for full continuum of forecasts from short-term to scenario and climate projections
- Leveraging of common backbone capabilities and need for an operational home



Discussion



Next Steps

- Collect views and comments from the LOTM on the resolution and the 4-pager
- Collect suggestions and options for moving forward
- Review of NEC/NEP presentation when developed



Backup Slides





Discussion

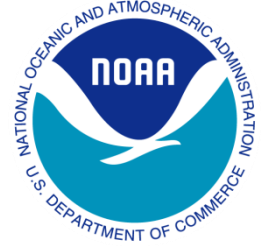


Strategic Questions for EFS Workgroup

- How best to integrate observations, research, modeling, forecast, and product delivery NOAA-wide?
- What needs to be considered with respect to skill assessment, liability, communication strategies, role of private enterprise?
- What does it mean to be operational – Backed by authority (quality controlled, liability), with specified uncertainties and delivered on a regular basis
- Should NOAA set itself on a path to become an operational ecological forecasting agency?



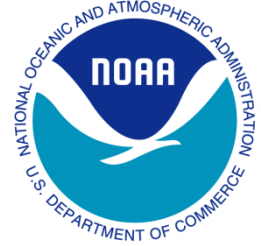
EFS Imperatives



- **Imperative #1. Organizational Commitment:** Agency-wide agreement that the construction of an operational and sustained ecological forecasting system (EFS) is a NOAA priority that necessitates strong cross-LO support, alignment of capacities, and leverages existing operational data and model infrastructure.
- **Imperative #2. Evaluation of User Needs:** An EFS must respond to the needs of our stakeholders. Their input must be used not only to develop the necessary ecological forecasts but also to verify their accuracy and refine them. Utilization of social and economic data to help set priorities for forecast development.
- **Imperative #3. Observation and Data Exploitation:** Increased acquisition and utilization of relevant observations and measurements to support reliable, continuous operational ecological forecast services.



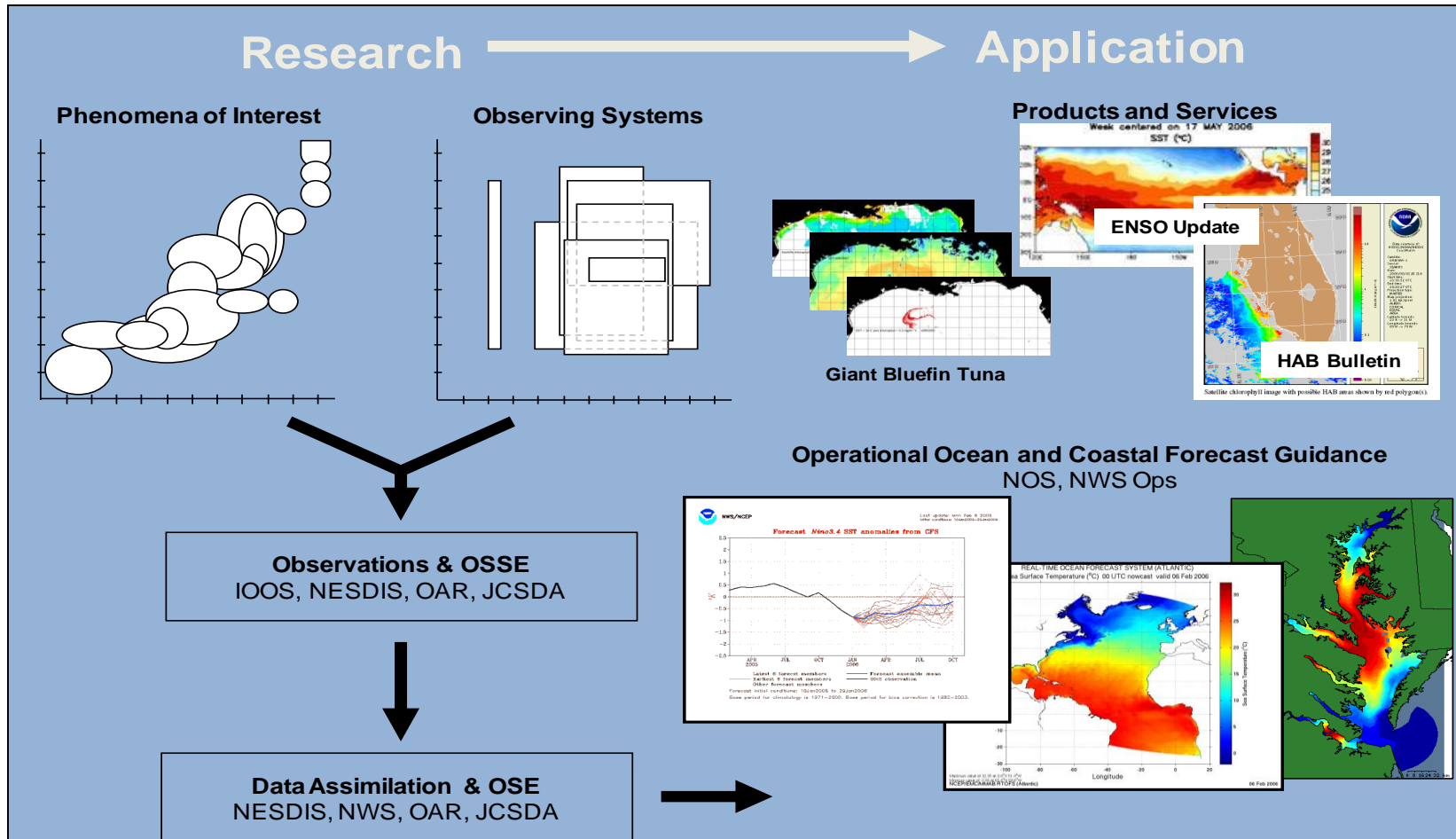
EFS Imperatives



- **Imperative #4. Model-based Forecasting Development and Integration:** Integration of physical models with biogeochemical and ecosystem models to provide operational forecasts that address specific ecosystem questions.
- **Imperative #5. Sustained Operations and Distribution:** Similar to the weather service, an ecological forecasting system must include a dedicated and reliable operational and delivery capability that will allow for the sustainable distribution of the ecological forecasts.
- **Imperative #6. Balance General Utility versus Specific Needs:** Creation of a system versatile enough to benefit a wider user community, yet specific enough to address regional to local decision making needs.

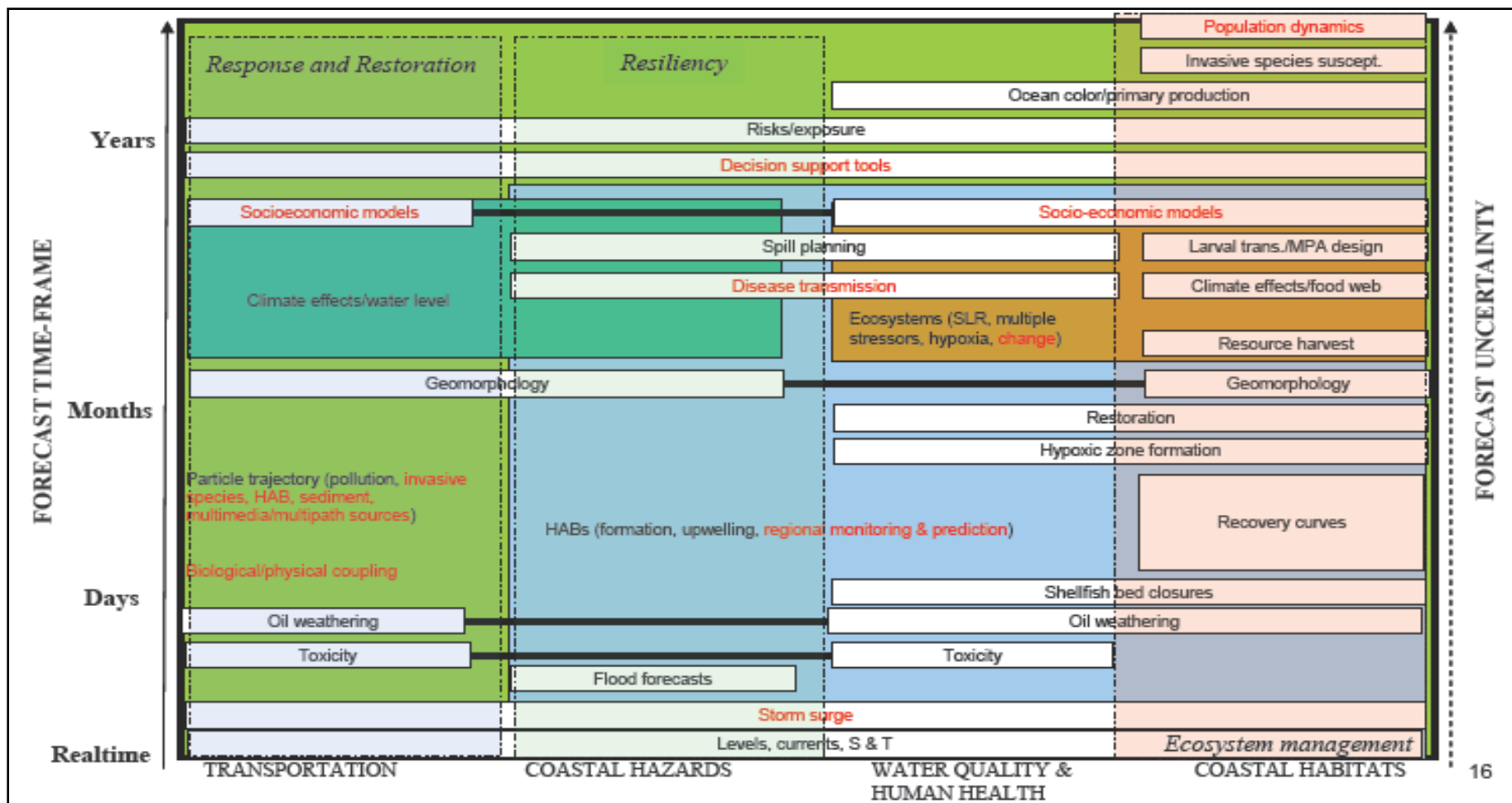
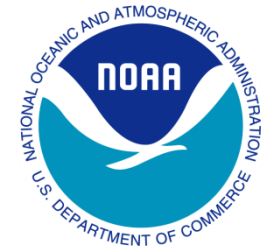


Concept of Operations



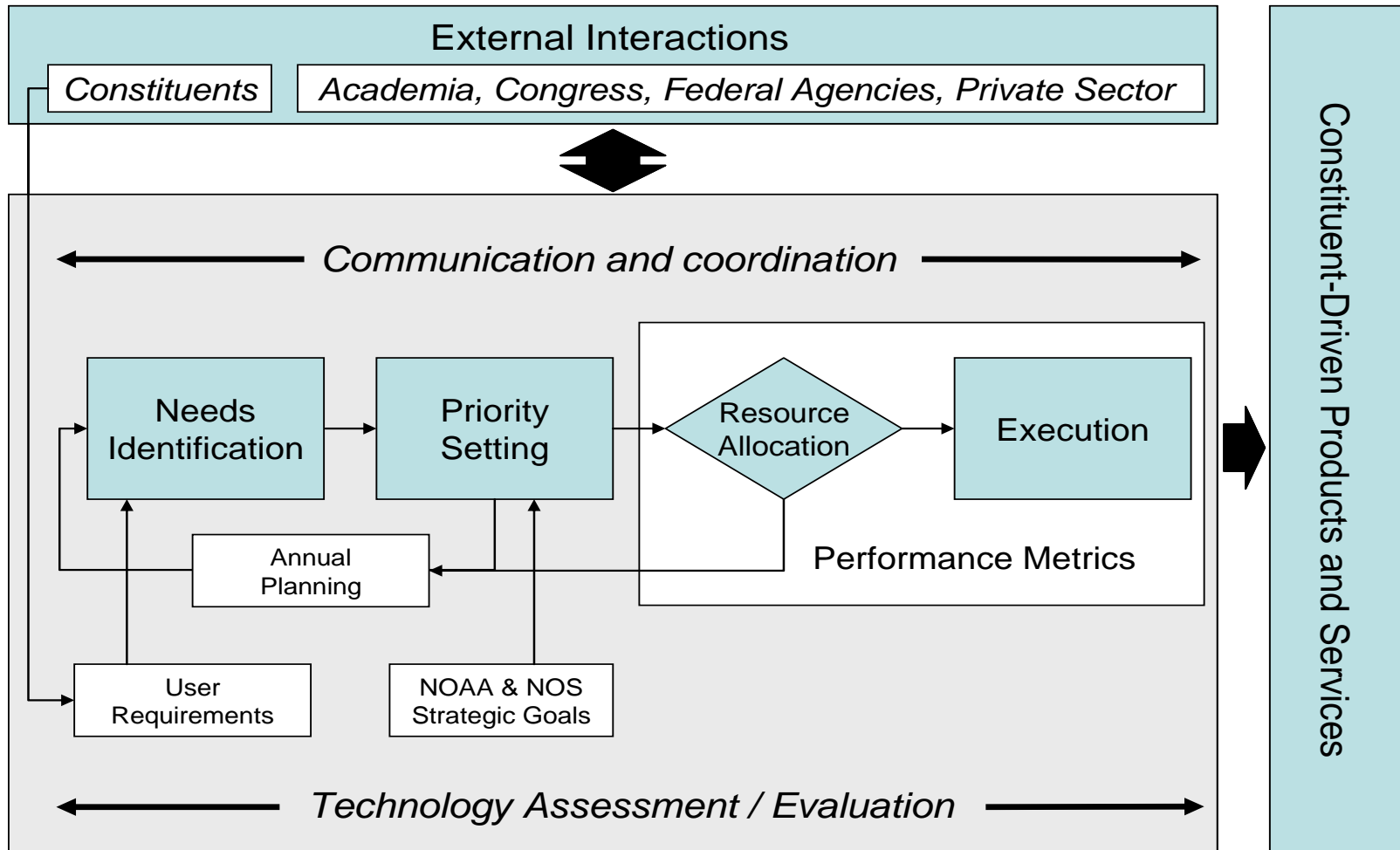


Seamless Suite of Products and Services





Requirements to Operations





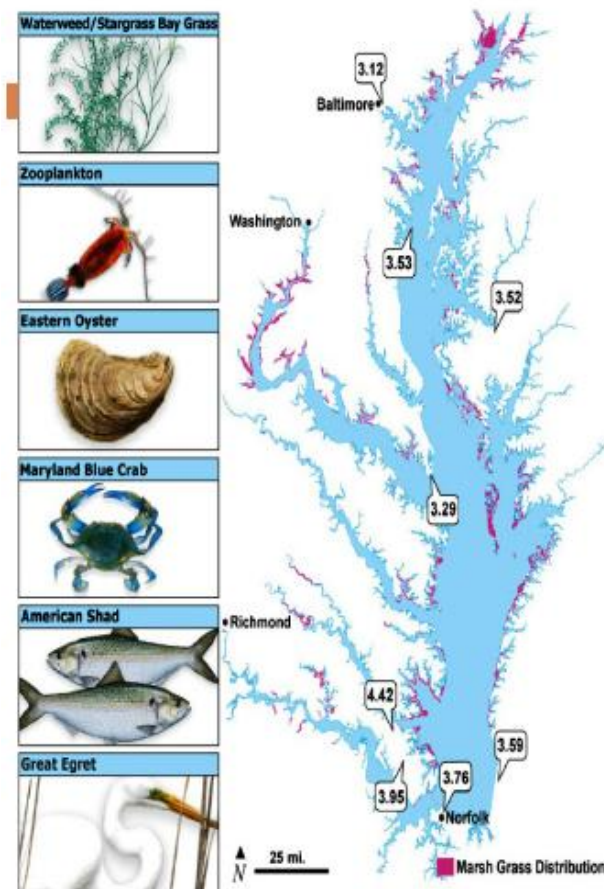
Toward a Regional Forecasting Capabilities: Chesapeake Bay Prototype



Objective: Develop a fully integrated model of the Chesapeake Bay and its tributaries, air, and watershed

Purpose:

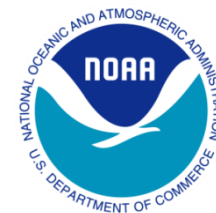
- Near-real time applications: Nowcasting and forecasting of the Bay circulation, ecosystem pathogens, harmful algal blooms, waves and inundation
- Climate Projections: Estimating effect of climate change, between now and 2050, on the health of the Bay and its watershed
- Provide decision support tools for users and stakeholders



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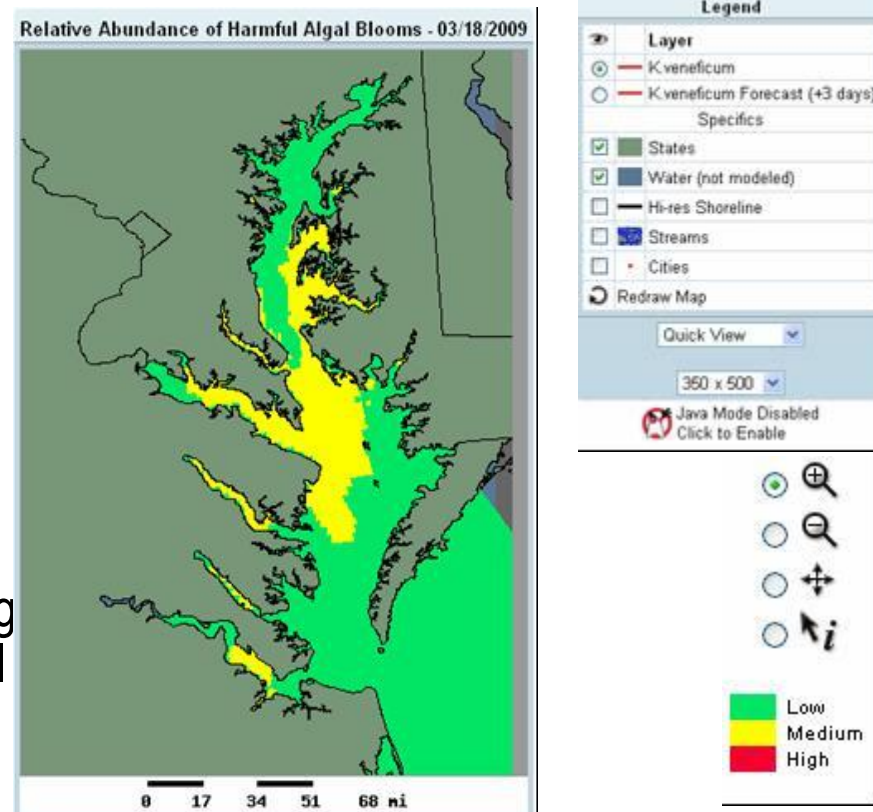


Harmful Algal Bloom (Chlorophyll)



Monitoring & Forecast System

- **Issue:** HABs threaten human health and natural resources
- **Solution:** Predict nature, extent, development and movement of HAB species in Bay and its tidal tributaries.
- **Operational Concept:** Routinely generate forecasts using data from hydrodynamic computer models and NOAA satellites.
- **Collaborators:** Include state natural resource partners
- **Output Product:** Near-real time maps showing when and where to expect initiation and landfall
- **Dissemination:** Online and Media
- **Outcome:** Actions taken to monitor and mitigate HAB effects.



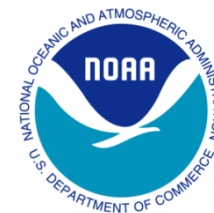
Nowcast of *K. veneficum* abundance
(Experimental product)

http://155.206.18.162/cbay_hab/

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Dissolved Oxygen [DO] Monitoring & Forecast System



- **Issue:** Some areas of the Bay have low oxygen levels threatening survival of species.
- **Solution:** Predictions and forecasts of hypoxia, including uncertainty related to nutrient loading and river flow
- **Operational Concept:** Routinely generate predictions and forecasts on synoptic to seasonal scales using data from hydrodynamic, circulation, watershed, atmospheric and water quality models
- **Collaborators:** Include state managers, scientists and fishers
- **Output Product:** Maps and decision support tools showing concentration and dead zones, habitat suitability, and marine assessments
- **Dissemination:** Online and Media
- **Outcome:** Regional actions taken to promote restoration and recovery



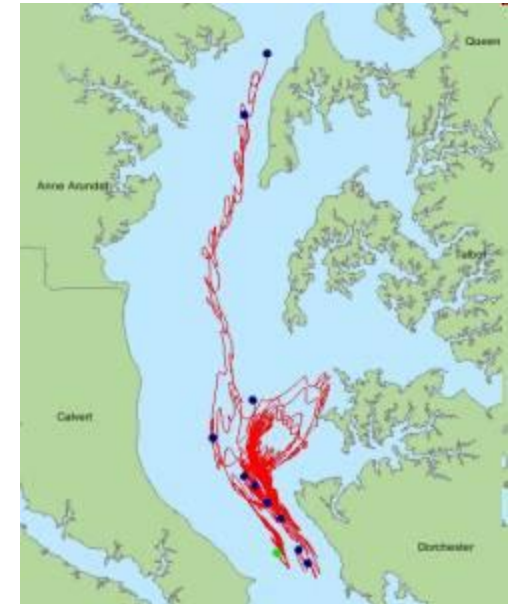
<http://www.eco-check.org/forecast/chesapeake/overview/>

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Living Resource Distribution/Oyster Monitoring & Forecast System

- **Issue:** Oyster populations are at low levels and productivity varies depending on salinity, water quality, habitat conditions, and disease.
- **Solution:** Annual forecast of oyster biomass including harvests and other related mortality/disease information
- **Operational Concept:** Routinely generate forecasts and outlooks using data from hydrodynamic, circulation, watershed, water quality, atmospheric and ecosystem models
- **Collaborators:** Include state managers, scientists and fishers
- **Output Product:** Maps and decision support tools showing habitat suitability, stock assessments, management and larvae tracking
- **Dissemination:** Online and Media
- **Outcome:** Actions taken to promote oyster restoration and disease research



***Chesapeake Bay Oyster
Larvae Tracker (CBOLT)***
<http://csc.noaa.gov/cbolt/>

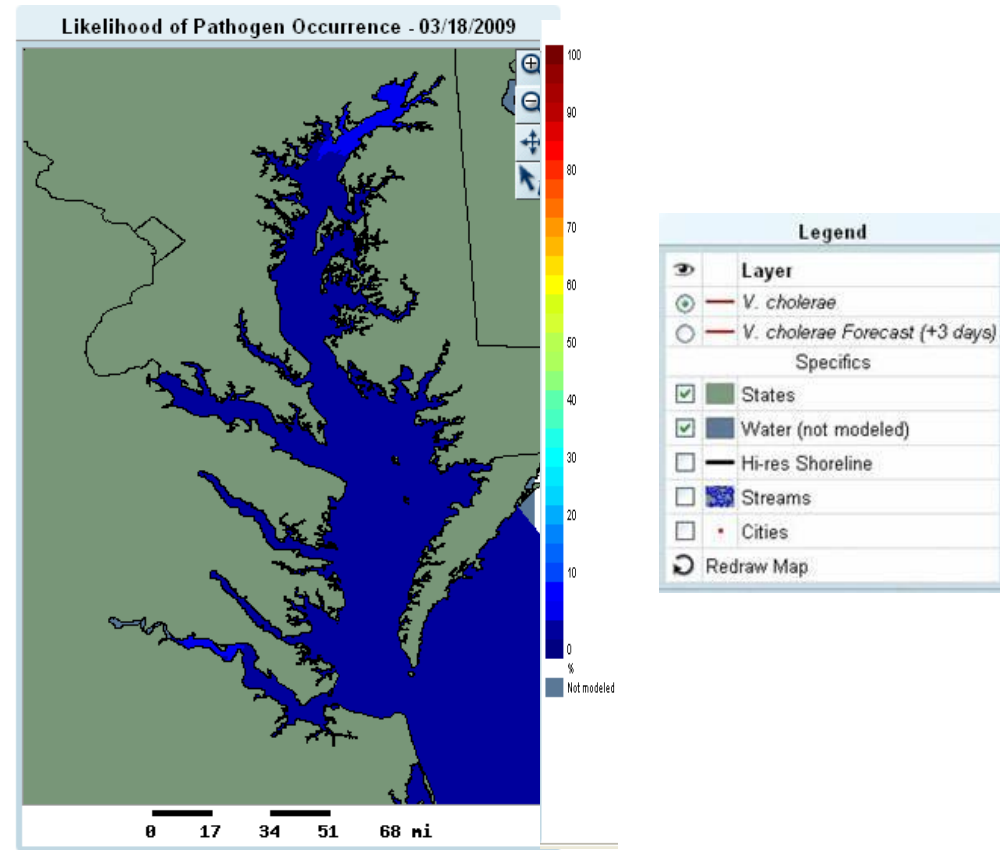
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Disease Pathogen Progression Monitoring & Forecast System



- **Issue:** Bacterial and viral pathogens – microorganisms capable of causing disease - threaten shellfish, fish species and human health
- **Solution:** Predict nature, extent, and spatially dependence of pathogens, including virulence probabilities in Bay and tidal tributaries
- **Operational Concept:** Routinely generate short- and long-term predictions using data from hydrodynamic and climate models, temperature and salinity, vibrio and multiple species, pathogen models and remote sensing data.



Near-real-time maps of *V. cholerae* likelihood

Experimental product

<http://155.206.18.162/pathogens/>

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